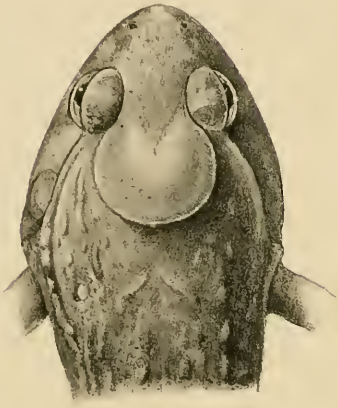
1.

2.

3.



4.

5.

5a.

5b.

J. Green, del.

RANA DORIÆ AND ITS ALLIES.

Explanation of Plate 9.

1. *Rana doriæ* Boulenger.
2. *Rana macrognathus macrognathus* Boulenger.
3. *Rana macrognathus dabana*, subsp. nov.
4. *Rana pileata* Boulenger.
5. *Rana kohchangæ*, sp. nov.

All the figures are of natural size and drawn from adult males.

THE FROGS ALLIED TO RANA DORIÆ.

By Malcolm A. Smith, F.Z.S.

With plate 9.

The frogs clustered round *Rana doriæ* Boulenger, form a small and compact group, easily separated from all other species affiliated to them, but not so readily distinguished among themselves. The reason for this difficulty lies in the fact that it is only by means of the unusual development which occurs in the heads of the adult males that separation is possible. In bodily configuration, in the position of the vomerine teeth, in the character of the skin, the extent of webbing to the toes, and in colouration, they closely resemble each other, so nearly, that where females or juveniles are concerned, it is practically impossible to distinguish between them. Clearly they are all derived from a common ancestor, and they might still, perhaps, be regarded as racial forms of one species. The male characters, however, are now so distinct and constant, and the range of each form appears to be so well defined,* without intermediate ones occurring that, with one exception, it seems advisable to accord them specific rank. In several localities, moreover, two forms are to be found together. Further information concerning the phylogenetic relationships of this group, may be forthcoming when all its tadpoles are known. I have so far been able to obtain only two of them. In all essential characters these two do not differ from each other.

The range of these frogs is throughout Siam and the regions immediately bordering thereon. They are hill dwellers, inhabiting the mountain streams at all levels up to 1000 metres; and where found they are usually abundant. Excepting *R. doriæ*, I have had the opportunity of seeing them all in their native haunts.

With the large amount of material now in my possession it is possible to review this group in considerable detail. I recognize five forms. Three of these, *R. doriæ*, *R. macrognathus* and *R. pileata* are already known. Two more are now added, *R. kohchangæ* and a new race of *R. macrognathus*.

---

*Except in the N. and N. E. where extensive collections have not yet been made.

Rana doriæ was the first to be described. It is the simplest of the group, in that the head of the male undergoes no special changes. In the other members the male head, as it arrives at maturity becomes markedly enlarged. This increase in size is particularly noticeable on the lower surfaces of the mandibles, in the enlargement of the masseteric and depressor muscles, in the greater size of the tympanum, and in the increased width of the interorbital region. A bony tooth-like process also develops in the lower jaw on either side of the symphysis.

In addition to these changes *R. macrognathus* and *R. pileata* develop a rounded swelling upon the top of the head, commencing at the interorbital region and extending backwards towards the occiput. In the former species this is to be seen simply as a swelling beneath the skin, in the latter it is flap–like, with a free margin behind and at the sides. It springs from the anterior extremities of the fronto-parietal bones, which are swollen and markedly pitted at this point. The swelling itself is composed of dense fibrous tissue, and is connected posteriorly to the skin above it by fibrous bands; in the case of *R. pileata* it is closely adherent to the skin all round the free margin of the flap.

The following key, based on adult male characters, will serve to distinguish the various forms:—*

Head not enlarged, no tooth-like projections in the lower jaw	*R. doriæ* Blgr.
Head enlarged, lower jaw with tooth-like projections	
No postorbital swelling	*R. kohchangæ*, nov.
Postorbital swelling rounded, reaching to level of anterior border of tympanum, heels overlapping	*R. macrognathus macrognathus* Blgr.
Postorbital swelling elongate, reaching to level of posterior border of tympanum, heels not overlapping	*R. macrognathus dabana*, nov.
Postorbital swelling flap-like with a free edge	*R. pileata* Blgr.

* The allied *R. plicatella* Stoliczka, has also an occipital knob, but with its characteristic dorsal folds of skin and shorter web to the toes is quite distinct from the forms discussed here.

Rana doriæ Boulenger.

PLATE 9, fig. 1.

Rana doriæ, Bouleng., Ann. Mus. Genov., 1887, (2) v, p. 482, pl. III, fig. I; idem, Fauna Malay Penin., Rept., 1912, p. 231 (in part); idem, Rec. Ind. Mus., 1920, xx, p. 49; Anderson, Journ. Linn. Soc. Zool., 1889, (Fauna of Mergui), xxi, pp. 336, 349; Annandale, Mem. Asiat. Soc. Bengal, 1917, vi, p. 133 (Andaman Ids).

Type locality, Tenasserim. Types in the British Museum.

Distribution. From the type locality southwards through Peninsular Siam to the Malay Peninsula. Undoubted records of this frog appear to be only from Tenasserim, from King and Elphinstone Islands (Mergui Archipelago), from Patiyu (P. Siam) and from the Andamans. Recently I have examined a specimen obtained at Kuala Teku, Gunong Tahan, Malay Peninsula, by the F. M. S. Museums collectors. The Robinson and Kloss expedition to Peninsular Siam in 1919, found this frog fairly common at Victoria Point (S. Tenasserim), and at Mamoh, Tapli, and Tung Pran, and a good series was obtained from these localities. Anderson records it as common on King and Elphinstone Islands.

Colouration. All the examples I have examined from Tenasserim and Siam are of the same colour, the predominating hue being olive brown with lighter and darker markings. The Gunong Tahan specimen is of a reddish-brown above, with small black markings; throat and chest handsomely marbled with brown.

Remarks. The tibio-tarsal articulation in some of my specimens from Peninsular Siam reaches the tip of the snout or beyond.

I have examined two examples from the Andamans kindly sent me by Dr. Annandale (Indian Mus. Nos. 9381, 10436), and they differ from my specimens in the following particulars:—the more anterior position of the vomerine teeth, from the extreme anterior inner borders of the choanae, the more emarginate web to the toes, the shorter, more rounded, inner metatarsal tubercle, and in the presence of a small, but distinct, outer metatarsal tubercle.

Measurements of *Rana doriæ* in mm.

Author's No.	3581	3582	3589	3592	3585	5922
Sex	♂	♀	♂	♀	♀	
Snout to vent	44	46	42	47	47	50
Length of head	16	17	15.5	16.5	17	18
Width of head	18	19	17	18	18	19
Snout	7.5	8	7	7	7	8
Eye	5	5	4.5	5	5	5
Interorbital width ..	4.5	4.5	4	5	4	4
Tympanum	3	3.5	3.5	3.5	4	4
Fore limb	24	28	23	27	27	26
Hind limb	78	86	70	83	86	80
Tibia	26	27	24	28	27	27
Foot	25	25	22	26	26	25
Locality	Tung Pran	Tung Pran	Tapli	Tapli	Mamoh	Ku. Teku

Rana macrognathus macrognathus Boulenger.

PLATE 9, fig. 2.

Rana macrognathus, Bouleng., Ann. & Mag. Nat. Hist., 1917 (8) xx, p. 414; idem., Rec. Ind. Mus., 1920, xx, p. 51.

The confusion between this species and *R. doriæ* which occurred in Boulenger's earlier descriptions (Ann. Mus. Genova, 1893, (2) xiii, p. 238, pl. viii, and Fauna Malay Penin., Rept., 1912, p. 231), has now been cleared by that authority himself.

The types are from the Karen Hills, Burma, and the species extends southwards as far as Lat 6° N. I have seen specimens from the Me Taw forest, W. of Raheng, from De Lisle island and Pulo Rawi off the W. coast of Peninsular Siam, and from the Nakon Sritamarat mountains.

In his recent monograph on the South Asian Ranae, Boulenger has listed under this species (p. 51) specimens of mine from Daban, Ok Yam, and Koh Chang, single examples in each instance. The one from Daban I now refer to *R. m. dabana*, the other two, from Ok Yam and Koh Chang, to *R. kohchangæ*.

Colour in life. Olive greenish or brownish, with darker markings. Throat white, belly and under surface of thighs pale yellow, the two colours usually clearly defined by the fold across the throat. Lips and limbs with dark bars, and a pale bar between the eyes. Iris golden, veined black with a black cross. A broad yellow vertebral stripe occurs in many examples, less often a narrow one.

Remarks. I found this frog common on the Nakon Sritamarat hills (Khao Ram, Khao Ronpibun, Khao Wang Hip) in February, both on the lower levels and up to 700 metres, where water became scarce. It was never found away from streams, and could be heard croaking frequently both by day and by night. Tadpoles abounded in the shallow puddles and pools, and were obtained in all stages of development.

The tadpole. This agrees in all essential characters with that of *R. kohchangæ*.

Two forms were found; a small one in which the length of the body is nearly twice its width and the nostrils are nearer the tip of the snout than the eyes; and a larger one in which the length of the body is about 1½ times its width and the nostrils are equidistant between the snout and the eyes. The second form appears to be one in which, owing probably to better nourishment, a greater development of the body occurs, altering somewhat its proportions. Mouth parts and colouration as in *R. kohchangæ*.

Dimensions of a specimen of the large form:—total length 31, head and body 11.5, depth of tail 5.5 mm. Of the small form:—total length 28, head and body 8.5, tail 3.5 mm.

Measurements of *R. m. macrognathus* in mm.

Author's No.	4410	1586	3894	6069	6070	6071	6073	6080	6078	6081	6084	6085	6088	1584	1585
Sex	♂	♂	♀	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♂	♀
Length	49	54	43	54	51	54	55	50	49	48	48	47	49	58	49
Length of head ..	21	21	16	22	22	22	23	20	20	17	18	17.5	18	24	17
Width of head ..	23	24	16.5	25	24	25	24	21	20.5	19	19	18	18	26	19
Snout	9.5	9.5	7	9	9	9.5	10	8.5	9	7.5	8	8	8.5	10	8
Eye	5.5	5.5	4.5	6	6	6	6	6	5.5	5.5	5.5	5	5.5	6.5	5.5
Interorbital width ..	5.5	6	4	6	6	6	6	5.5	5	4	4.5	4	4	6.5	4
Tympanum	7	6	3.5	5.5	6	6	6	6	5.5	4	3.5	3.5	3.5	7.5	3.5
Fore limb	30	27	25	30	29	29	31	27	27	26	27	27	27	32	27
Hind limb	81	86	79	89	88	88	92	84	85	76	79	78	82	96	83
Tibia	29	28	26	31	29	30	30	28	28	26	27	26	27	33	27
Foot	29	27	24	28	27	28	28	26	27	25	25	25	26	31	26
Locality	De Lisle Id.	Me Taw forest Raheng	Me Taw forest Raheng.	Nakon Sritamarat.	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

Rana macrognathus dabana, subsp. nov.

PLATE 9, fig. 3.

Rana macrognathus (in part), Bouleng., Rec. Ind. Mus., 1920, xx, p. 51.

Types, male, Author's No. 4845, and female, 4842, collected at Daban, 200 metres altitude, Langbian plateau, S. Annam, in March 1918.

Similar to *R. m. macrognathus* Boulenger, but differing in the shorter leg, the heels not, or only just touching each other when the limbs are folded at right angles to the body; and in the longer postorbital swelling, which extends as far as a line connecting the posterior borders of the tympana.

Colour. As in *R. m. macrognathus*, but duller above and greyer below. None has a vertebral stripe.

Five males and one female examined. This frog was found along the banks of the Kronfa river, hiding among damp leaves at the water's edge.

Measurements of *R. m. dabana* in mm.

Author's No.	4845	4842	2637	2547	4844
Sex.	♂	♀	♂	♂	♂
Length	54	39	55	52	51
Length of head	22	14.5	22	22	21
Width of head	25	16.5	26	25	24
Snout	10	6.5	10	10	9.5
Eye	6	5	6	5.5	5.5
Interorbital width	6	3	6	5	5.5
Tympanum	6	3	6	5.5	5.5
Fore limb	30	22	33	30	30
Hind limb	81	60	80	75	75
Tibia	26	20	26	24	25
Foot	26	20	26	24	25

Rana pileata Boulenger.

PLATE 9, fig. 4.

Rana pileata, Bouleng., Journ. N. H. Soc. Siam, 1916, ii, p. 52, pl.—; idem., Rec. Ind. Mus., 1920, xx, p. 52.

This form is the largest of the group, and it has diverged the furthest from the primitive form. In it the head attains a remarkable development, for in addition to the usual cranial enlargement, the postorbital swelling becomes produced as a rounded flap, free behind and at the sides. I have nothing to add to Boulenger's excellent description of this species.

Type locality. Khao Sebab, Chantabun, S. E. Siam. Types in the British Museum.

Measurements of *R. pileata* in mm.

Author's No.	1551	1559	5881	3006	1564	5877	5833	5700	5695	3719
Sex.	♂	♂	♂	♂	♂	♀	♀	♀	♀	♂
Snout to vent ..	64	56	53	52	61	51	59	54	49	44
Length of head ..	26	21	20	23	29	18	21	20	19	18
Width of head ..	31	24	23	25	33	20	24	22	20	20
Snout	11	9	9	9	12	8	9	9	8	7.5
Eye	6.5	6	6	5	6.5	5.5	6	5.5	5	4.5
Interorbital width ..	8	5	5	6.5	8	4	4.5	4.5	4.5	4.5
Tympanum ..	6	5	4	4.5	6.5	4	4.5	4	3.5	4.5
Fore limb ..	35	31	31	27	34	26	33	32	29	24
Hind limb ..	97	87	88	78	90	72	93	90	78	66
Tibia	32	29	29	25	29	24	30	29	26	22
Foot	31	29	29	25	29	24	30	28	26	22
Locality	Khao Sebab.	Khao Pleung.	Pa Meang.	Me Pooan.	Me Ing.	Me Song.	Pa Meang.	Muang Liep.	Nong Bua.	Me Taw.

Distribution. Hills of Siam except in the south-west. I have altogether examined some 60 examples from the following localities:—

Khao Sebab and Hup Bon (S. E. Siam); Khao Pleung, Me Song forest, Nong Bua, Me Pooan, Me Wang and Pa Meang (N. Siam); Me Taw forest (N. W. Siam); Muang Liep, Huey Kan Luang and Pon Pissay in French Laos on the Upper Mekong.

The age at which the head of the male reaches its maximum development is not always commensurate with the size of the frog. Specimens 1551, 1564 and 3006 are fully grown, the flap is large with a good free edge, and the general proportions of the head those of maturity. Nos. 1559 and 5881 although also fully grown as regards body length, still have the flap only as a small fold of skin, while the other developments of the head are in proportion. From rough observations which I have been able to make, I believe the cranial enlargement commences during the third year of life.

Rana kohchangæ, sp. nov.

PLATE 9, fig. 5.

Rana doriæ, Smith & Kloss, Journ. N. H. Soc. Siam, Dec. 1915, i, p. 249.

Rana macrognathus (in part), Bouleng, Rec. Ind. Mus., 1920, xx, p. 51.

Types male and female, Author's Nos. 2976 and 2985 respectively. Collected on Koh Chang (Chang Island) in the Inner Gulf of Siam, Oct. 1918. Types presented to the British Museum; paratypes 2978 and 2980 to the Museum of Comparative Zoology, Harvard College.

Description of the male type. Vomerine teeth in two short oblique series, commencing from the posterior borders of the choanae, a little nearer to each other than to the borders of the choanae. Lower jaw with fang-like projections. Head broader than long; snout rounded, scarcely projecting beyond the mouth, longer than the eye; canthus rostralis obtuse, loreal region slightly concave; nostril a little nearer the tip of the snout than the eye; distance between the nostrils greater than the interorbital width, which is greater than that of the upper eyelid; tympanum very distinct,

larger than the eye. Fingers moderate, the tips swollen into very small discs, first as long as second, third as long as the snout; subarticular tubercles moderate. Hind limb moderate, the tibio-tarsal articulation reaching to between the eye and the tip of the snout; heels slightly overlapping when the limbs are folded at right angles to the body. Toes moderate, the tips dilated into small but very distinct discs, nearly fully webbed, two phalanges of the fourth toe free. A well marked tarsal fold; inner metatarsal tubercle moderate, half the length of the fifth toe; no outer tubercle.

Skin of the upper parts with rounded glandules or short folds; a strong, curved fold from the eye to the shoulder.

Nasal bones in contact.

Olive brown above, with lighter and darker markings; a pale bar between the eyes; lips and limbs with dark bars. Below yellowish white.

Female, similar to the male, but without any enlargement of the head or tooth-like projections to the lower jaw.

Males with internal vocal sacs.

Variation. Forty examples from the type locality shew but little variation from each other. The first finger may be a little longer than the second; the hind limb in some males reaches only to the eye, while in other (younger) specimens it reaches as far as the nostril.

Two examples have a broad yellow vertebral stripe.

This frog is the smallest of the group. From. *R. doriæ* it differs in the enlargement of the head and tooth-like projections in the lower jaw. From *R. macrognathus* and *R. pileata* in the absence of any postorbital prominence.

Distribution. Besides on Koh Chang this frog has been found on the neighbouring islands of Kut and Mehsi, and on the adjacent mainland at Ok Yam.

Its presence on the mainland, in view of the closely related forms of this group, is of particular interest, for *R. pileata*, with its very distinct occipital flap is found on the same coast only 125 km. distant.

Measurements of *R. kohchangæ* in mm.

Author's No.	2976	2985	2978	2980	2979	2984
Sex.	♂	♀	♂	♀	♂	♀
Snout to vent ..	42	41	42	42	40	39
Length of head ..	17	14	17	15.5	17	14
Width of head ..	18.5	15	19	16	18	15
Snout	7	6	6	6.5	7	6
Eye	4.5	5	5	5.5	5	5
Interorbital width ..	4	3.5	4.5	3	3	3
Tympanum	5	3	5	3	5	2.5
Fore limb	24	23	25	24	22	22
Hind limb	66	65	65	65	62	59
Tibia	21	21	22	22	19	19
Foot	20	20	21	21	18	18

DESCRIPTION OF THE TADPOLE.

Head and body. Length about one and three-quarters times its breadth, much flattened above and below, snout rounded. Nostrils nearer the tip of the snout than the eyes. Eyes looking outwards and upwards. Spiraculum sinistral, much nearer the eye than the vent. Anus dextral.

Mouth. Subterminal, small. Beak edged with black. A fringe of papillae at the sides and below. Upper lip with two series of teeth, the lower one interrupted; lower lip with three series, the uppermost narrowly interrupted, the second continuous and of about the same length, the third only half the length.

Tail. Four times as long as deep, tip pointed; crests moderate, upper and lower about equal.

Colour in life. Reddish or brownish olive, spotted and speckled with darker. Below greyish, uniform.

Measurements of a specimen with the hind legs well developed:—total length 35; head and body 12; depth of tail 5.5 mm.

THE FROGS ALLIED TO RANA DORIÆ. ADDENDUM.

By Malcolm. A. Smith., F.Z.S.

With a text figure.

Rana plicatella Stoliczka.

Rana plicatella, Bouleng., Rec. Ind. Mus., 1920. xx, p. 53.

Since the publication of the above article (*ante* pp. 215-225), I have been fortunate in obtaining three adult male examples of *Rana plicatella*. They were caught on Bukit Fraser, Pahang, in the Malay Peninsula at about 1200 metres altitude.

These specimens are larger than any previously known. and shew probably the cranial development in its most extreme degree.

Head of *R. plicatella*, natural size.

Although easily distinguished by its glandular dorsal folds and less fully webbed toes from the other forms allied to it, this frog very clearly belongs to the same group, and must be included in it. The cranial enlargements are of precisely the same nature, the only variation being in the shape of the occipital prominence. This covers about the same area as that of *R. m. macrognathus*, but instead of being only a slight swelling beneath the skin, projects abruptly upwards at its posterior extremity for from 1.5 to 2 mm.

The colouration of the specimens is olive or olive-brownish above with black markings, a black chevron being just distinct; two examples had bright orange shades, in life, upon the arms and legs, and there are black cross bars upon the limbs of all. Below pale sulphur-yellow, the throat and hind limbs speckled with black. Two of the specimens have a broad orange-yellow vertebral line.

This frog appears to be confined to the Malay Peninsula. The type specimen came from Penang or Province Wellesley and is now lost. Flower's specimen came from Penang, and there is one in the British Museum from Singapore. I have another from Gombak, Selangor, a female with ripe ova (No. 1592).

Tadpoles (taken in June), and juveniles just leaving the water, which I identify as those of *Rana plicatella* were also obtained. The larva differs from that of *R. m. macrognathus* and *R. kohchangæ* in the longer and narrower tail, and in that the upper crest does not reach to the root of the tail. I take this opportunity to add some details of description which were omitted previously.

Length of head and body one and a half to one and two-thirds times its breadth. Nostrils a little wider apart than the distance between the eyes, equidistant between them and the tip of the snout. Spiraculum visible both from above and below. Mouth with a single short row of papillae on the sides, with one or two rows of more elongate ones below, not interrupted in the mid-line.

Tail five times as long as deep, the crests somewhat narrow, the upper a little higher than the lower and not reaching to the root of the tail.

Measurements of a specimen with hind legs well developed :—

Total length 34 mm ; head and body 11.5 ; depth of tail 4.5.

The study of this small group of frogs, from an evolutionary point of view is of great interest, for in this case there can hardly be any doubt that they are all derived from the same ancestor. The one doubt refers to *R. doriæ*, which, being the least specialized I have assumed to be the progenitor, but which now, in its lack of cranial enlargement and want of tooth-like projection in the lower jaw, is farther separated from the various members of the group than they are from each other.

Considering the comparatively small area of country over which these frogs are spread, the number of forms which have been evolved is indeed remarkable, and all the more so when we consider that the conditions under which they all live are almost identical.

Measurements of *R. plicatella* in mm.

Author's No.	6510	6511	6512	1592
Sex.	♂	♂	♂	♀
Snout to vent ..	43	43	43	29
Length of head ..	17	16	17	10
Width of head ..	20	20	19.5	11
Snout	7	7	7	4
Eye	4.5	4.5	4.5	3
Interorbital width ..	5.5	5	5.5	2.5
Tympanum	5	4	4.5	3
Fore limb	24	25	24	17
Hind limb	70	75	77	51
Tibia	24	25	26	17
Foot	22	23	24	15